QUARTERLY JOURNAL
of the
FLORIDA ACADEMY OF SCIENCES

Vol. 33 June, 1970 No. 2

Vegetational Changes in the National Key Deer Refuge

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The Key deer, *Odocoileus virginianus clavium* Barbour and Allen, is a distinct geographic race that inhabits the southernmost Keys of Florida (Barbour and Allen, 1922). Today they are restricted to the Keys within the National Key Deer Refuge that was established in 1954. According to the U. S. Fish and Wildlife Service pamphlet, RL-518 (1965), only about 50 deer existed in 1957 and the future of the herd was in doubt. The herd estimate in 1965 was 300. It is now (1969) estimated at about 400.

Prior to the establishment of the Refuge, the junior author began an extensive study of the deer and the Keys they inhabited. The published reports (Dickson, 1955; Dickson, Woodbury, Alexander, 1953) contain the first ecological study of the deer habitat on a Key-by-Key basis. Big Pine Key was found to be the Key most used by deer and the northern part of this Key is in the Refuge.

When the original study was started in 1951, a prominent feature at the north end of Big Pine Key was an open grass prairie measuring one-half mile in length and one-fifth of a mile in width. There was limited evidence of its use by deer. A few small shrubs were scattered throughout the area. It was bounded on the east by a mangrove community and on the west by a community of West Indian broad leaved trees and shrubs. The soil was a shallow marl in contrast to the rocky surface of most of the Key. Local reports and physical evidence supported the belief that the prairie had been farmed in the past. Fires had been of common occurrence prior to 1951 and served to maintain the grasses and suppress the shrubs. The Refuge was put under strict fire control, and by the summer of 1967 it was apparent that an extensive vegetational change had occurred.

The study now reported was made in June of 1968 to determine the exact nature of the floral and vegetational changes between 1951 and 1968 in the prairie area and to evaluate them in terms of potential effect on the deer population.

Methods

Thirty quadrats, 3 × 10 feet, were studied. An attempt was made to randomly sample the area and follow procedures previously reported (Dickson, 1955), so that the current data could be compared directly with those of 1951. Plant names, numbers, heights and per cent of cover were determined. The last was recorded as four classes: 1 (less than 1 per cent); 2 (1-5 per cent); 3 (5-25 per cent), and 4 (25-50 per cent). Frequency figures are the percentage of quadrats in which a species occurred. Density values are the average number of individuals per quadrat. Counts for trees and shrubs were converted to plants per acre. Species found in 1968 but not in 1951 were noted. Plants browsed by deer were also noted, based on information determined in 1951 from stomach and pellet analyses, and direct observations. Plant names used are from the checklist of Lakela and Craighead (1965).

Results and Discussion

Comparison of data in Tables 1 and 2 shows that the number of species doubled in the sixteen-year period between the studies. This diversification was characterized by a shift favoring woody species. The most spectacular species change involved *Sporobolis virginicus* that had a frequency drop from 100 to 40 and cover class from 4 to 2. In 1951 this grass gave the area its characteristic appearance of a grassland. The change appears to be related more to an indirect shade-effect from young trees and shrubs than a direct response to fire control. Observations indicate the species has very little shade tolerance. Loss of this species is not likely to directly effect the deer, since there is no record of its being browsed. Reduction in the dense grass cover makes the habitat less fire-prone. *Sporobolis* has been replaced by several grasses and sedges that have different growth habits and do not cover the ground so completely. For example, *Abildgaardia monostachya,* a sedge not found in 1951, was common in 1968.

Less change occurred among the semi-woody species that were important in 1951, *Randia aculeata, Morinda roioc, Waltheria amer-*

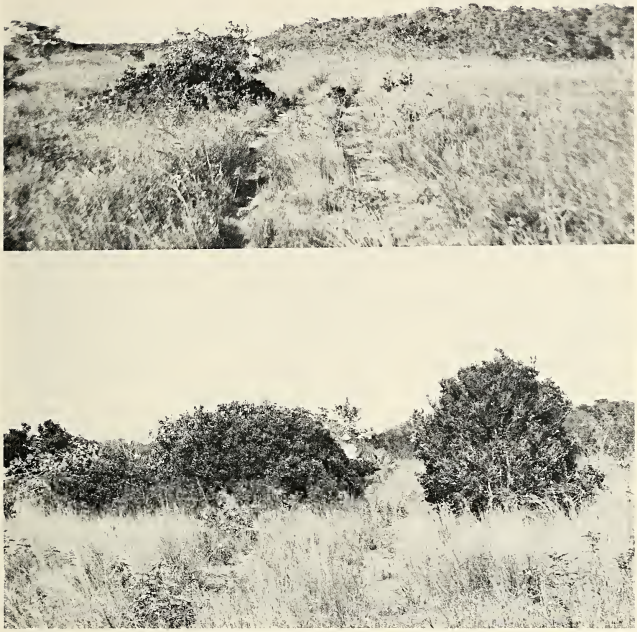

Fig. 1. Upper 1951 photograph; Lower 1968 photograph. Note growth of *Eugenia myrtoides* on the right of the jeep track.

icana and *Solanum blodgettii*. The change in importance of woody species was due largely to invasion by new species. It is the rapid growth of these invading species that changed the appearance of the habitat so dramatically (Fig. 1).

Of the known deer food species, *Bumelia celastrina* and *Pithecellobium guadelupense* increased and *Acacia peninsularis, Agalinis maritma, Cassytha filiformis, Chamaesyce scoparia* and *Ximenea americana* all decreased. Those showing very little change were *Conocarpus erecta, Morinda roioc, Neptunia pubescens, Ran-*

dia aculeata and *Solanum blodgettii.* It is recognized that our knowledge of the plants used as food by these deer is incomplete at this time. It is very likely they make use of many of the invading species.

Data in Table 3 show the extent of change caused by the invasion of woody species. They also indicate that succession had advanced toward the climax community of plants of West Indian affinity (Alexander, 1958, 1967). These species existed along the west edge of the prairie in 1951. Propagules were available in quantity. All that was needed, apparently, was freedom from fire

TABLE 1
1951 plant list and analyses

Species	Frequency	Density	Cover
Sporobolus virginicus	100	—	4
Chamaesyce scoparia	90	13.1	2
Randia aculeata	90	7.5	3
Grass (unidentified)	80	6.9	3
Flaveria linearis	70	1.8	2
Morinda roioc	70	3.3	2
Waltheria americana	60	7.6	2
Solanum blodgettii	50	2.9	2
Agalinis maritima	40	1.9	2
Cassytha filiformis	40	0.4	1
Chloris petraea	40	0.9	2
Evolvulus alsinoides	40	0.5	1
Borrichia frutescens	30	4.8	1
Physalis angustifolia	30	0.6	1
Acacia peninsularis	20	0.6	3
Conocarpus erecta	20	0.2	2
Cynanchum blodgettii	20	0.3	1
Pithecellobium guadelupense	20	0.8	2
Setaria geniculata	20	0.8	2
Sideranthus megacephalus	20	0.2	1
Andropogon sp.	10	0.2	2
Bumelia celastrina	10	1.1	2
Croton linearis	10	0.1	1
Neptunia pubsecens	10	0.1	1
Passiflora pallida	10	0.1	1
Piscidia piscipula	10	0.1	1
Portulaca phaeosperma	10	0.4	1
Ximenia americana	10	0.1	2

TABLE 2

1968 plant list and analyses

	Frequency	Density	Cover	Not found in 1951	Deer Food
Paspalum blodgettii	76.6	11.8	2		
Morinda roioc	76.6	3.9	1		*
Randia aculeata	73.3	7.9	3		*
Flaveria linearis	73.3	4.4	1		
Abildgaardia monostachya	63.0	5.1	2	*	
Solanum blodgettii	56.6	3.9	2		*
Waltheria americana	56.6	3.3	1		
Chamaesyce scoparia	53.3	1.6	1		*
Fimbristylis castanea	50.0	3.9	1		
Andropogon gracilis	40.0	3.6	1		
Sporobolus virginicus	40.0	2.3	2		
Pithecellobium guadelupense	33.3	0.8	2		*
Andropogon glomeratus	33.3	0.6	1		
Agalinis maritima	26.6	0.9	1		*
Croton linearis	26.6	0.8	1		
Conocarpus erecta	26.6	0.5	3		*
Cassytha filiformis	26.6	0.3	1		*
Chiococca alba	26.6	0.3	1	*	
Sideranthus megacephalus	23.3	5.7	1		
Bumelia celastrina	23.3	1.0	2		*
Cassia bahamensis	23.3	1.0	1	*	
Polygala grandiflora var. leiodes	23.3	0.3	1	*	
Evolvulus alsinoides	20.0	0.9	1		
Eugenia myrtoides	20.0	0.6	2	*	
Byrsonima cuneata	16.6	0.3	2	*	
Metopium toxiferum	16.6	0.3	2	*	
Physalis angustifolia	13.3	0.3	1		
Aristida purpurascens	13.3	0.1	1		
Coccoloba uvifera	13.3	0.1	2	*	
Sporobolus domingensis	10.0	2.3	1		
Setaria geniculata	10.0	0.2	1		
Reynosia septentrionalis	10.0	0.3	1	*	
Acacia peninsularis	10.0	0.1	1		*
Passiflora pallida	10.0	0.1	1		
Eugenia longipes	6.6	0.06	1	*	
Neptunia pubescens var. floridana	6.6	0.06	1		*
Rhacoma crossopetalum	6.6	0.06	1	*	

TABLE 2 (cont.)
1968 plant list and analyses

	Frequency	Density	Cover	Not found in 1951	Deer Food
Thrinax microcarpa	6.6	0.06	1	*	*
Cynanchum blodgettii	6.6	0.02	1		
Melanthera parvifolia	3.3	0.5	1	*	
Eustoma exaltatum	3.3	0.3	1	*	
Borrichia arborescens	3.3	0.1	1	*	
Borrichia frutescens	3.3	0.1	1		
Chloris petraea	3.3	0.1	1		
Stachytarpheta jamaicensis	3.3	0.1	1	*	
Rhacoma ilicifolia	3.3	0.06	1	*	
Spartina spartinae	3.3	0.06	1		
Ipomoea sagittata	3.3	0.03	1	*	
Jacquemontia pentantha	3.3	0.03	1	*	
Jacquinia keyensis	3.3	0.03	1	*	
Manilkara emarginata	3.3	0.03	1	*	
Piscidia piscipula	3.3	0.03	1		
Serenoa repens	3.3	0.03	1	*	
Urechites lutea	3.3	0.03	1	*	
Ximenia americana	3.3	0.03	1		*

for seedling establishment. Changes in height of the woody species was very striking. In 1951 the shrubs and young trees were not over 2 feet tall and most were under 1 foot. By 1968 these were in the 4-12 feet range. There were areas where impenetrable thickets were forming and approaching the conditions present in the mature climax stands of mature subtropical forests on Big Pine Key.

It is characteristic for these woody species to grow thickly and self-prune their lower branches, leaving very little good browse within reach of the deer. The mature subtropical forest interior is not a good feeding place, although deer do bed down here. It is reported that deer respond best to browse plants in early stages of succession or to those of fire-type communities (Vogl, 1967). Fire keeps woody plant browse within reach of the deer. Komarek (1966) discussed means of keeping vegetation as it is or adjusting it by use of fire for the best support or production of wildlife. Robertson (1953) in discussing fire on marl glades stated that fire kills back seedlings of woody plants that have become established between fires and thus acts to slow the invasion of shrub vegetation into the glade.

TABLE 3

Evidence of change toward typical subtropical hardwood forest 1951-1968

Species	'51 Typical Forest			'68 Northern Prairie			'51 Northern Prairie		
	Freq. %	Cover	Plants Per Acre	Freq.	Cover	Plants Per Acre	Freq.	Cover	Plants Per Acre
Randia aculeata	85.7	2	2,744	73.3	3	11,470	90.0	3	10,890
Metopium toxiferum	80.0	3	2,702	16.6	2	436			
Reynosia septentrionalis	74.3	3	1,682	10.0	1	436			
Thrinax microcarpa	60.0	3	489	6.6	1	87			
Pithecellobium guadelupense	54.6	3	2,214	33.3	2	1,162	20.0	2	1,162
Eugenia axillaris and *myrtoides*	45.7	2	2,030	20.0	2	871			
Bumelia celastrina	40.0	2	555	23.3	2	1,452	10.0	2	1,597
Piscidia piscipula	40.0	3	240	3.3	1	44	10.0	1	145
Manilkara emarginata	31.4	2	191	3.3	1	44			
Byrsonima cuneata	22.9	2	99	16.6	2	436			
Eugenia longipes	22.9	2	439	6.6	1	87			
Coccoloba uvifera	14.3	1	83	13.3	2	145			
Jacquinia keyensis	11.4	1	58	3.3	1	44			
Coccothrinax argentea	8.6	1	83						
Rhacoma crossopetalum	8.6	1	34	6.6	1	87			
Ximenia americana	8.6	2	91	3.3	1	44	10.0	2	145
Serenoa repens	2.9	1	8	3.3	1	44			

Parts of the marl prairie area had been control-burned in March of 1968, three months before the present study was done. The fire had killed the tops of many of the woody species. However, root-sprout recovery was in evidence everywhere in the burn. Ground cover plants had also recovered. Apparently no plant species had been eliminated. There were deer tracks and groups of pellets, indicating use of the burned and near-by unburned shrubby areas. As a deer habitat, the combination of burned and unburned areas seems an improvement over the open grass prairie of 1951.

The old prairie area of northern Big Pine Key is too limited in size to support many deer. This is true of the entire range available to these deer. Human pressure is increasing daily and reducing the amount of land outside the Refuge that is available to the deer. As the deer are pressured into less space than they are now using, careful management of the vegetation in the Refuge is paramount. This study done in a tropical environment documents the rapidity with which parts of the Refuge area can change under total fire protection. The other vegetation types in the Refuge are being studied to determine change since the 1951 study. Data from these show that a considerable difference in rate of change characterizes each of the various Key habitats and suggest that different control procedures be carefully evaluated for each vegetation type within the Refuge.

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